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Hwang et al.

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(54) **METHOD AND APPARATUS FOR SUPPORTING DEVICE-TO-DEVICE COMMUNICATIONS**

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H04W 8/26 (2009.01)
H04W 76/02 (2009.01)

(52) **U.S. Cl.**
CPC ***H04W 36/08*** (2013.01); *H04W 8/26* (2013.01); *H04W 76/023* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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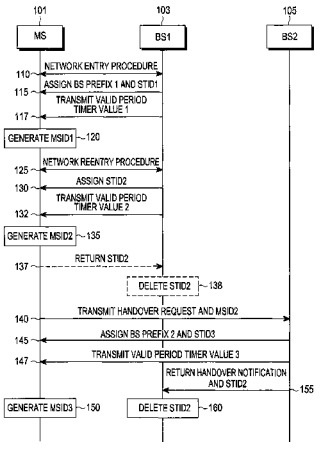
(57) **ABSTRACT**

A method for supporting Device-to-Device (D2D) communications by a Mobile Station (MS) in a communication system is provided. The method includes performing a network entry procedure with a Base Station (BS) and receiving, from the BS, a BS prefix, a temporary Identifier (ID), and a valid period timer value for the temporary ID, generating a device ID using the BS prefix and the temporary ID, and performing, upon detecting data to be transmitted, communication with a peer MS using the device ID for a time indicated by the valid period timer value. The BS prefix is information unique within the communication system, and the temporary ID is information unique within a coverage area of the BS.

16 Claims, 5 Drawing Sheets



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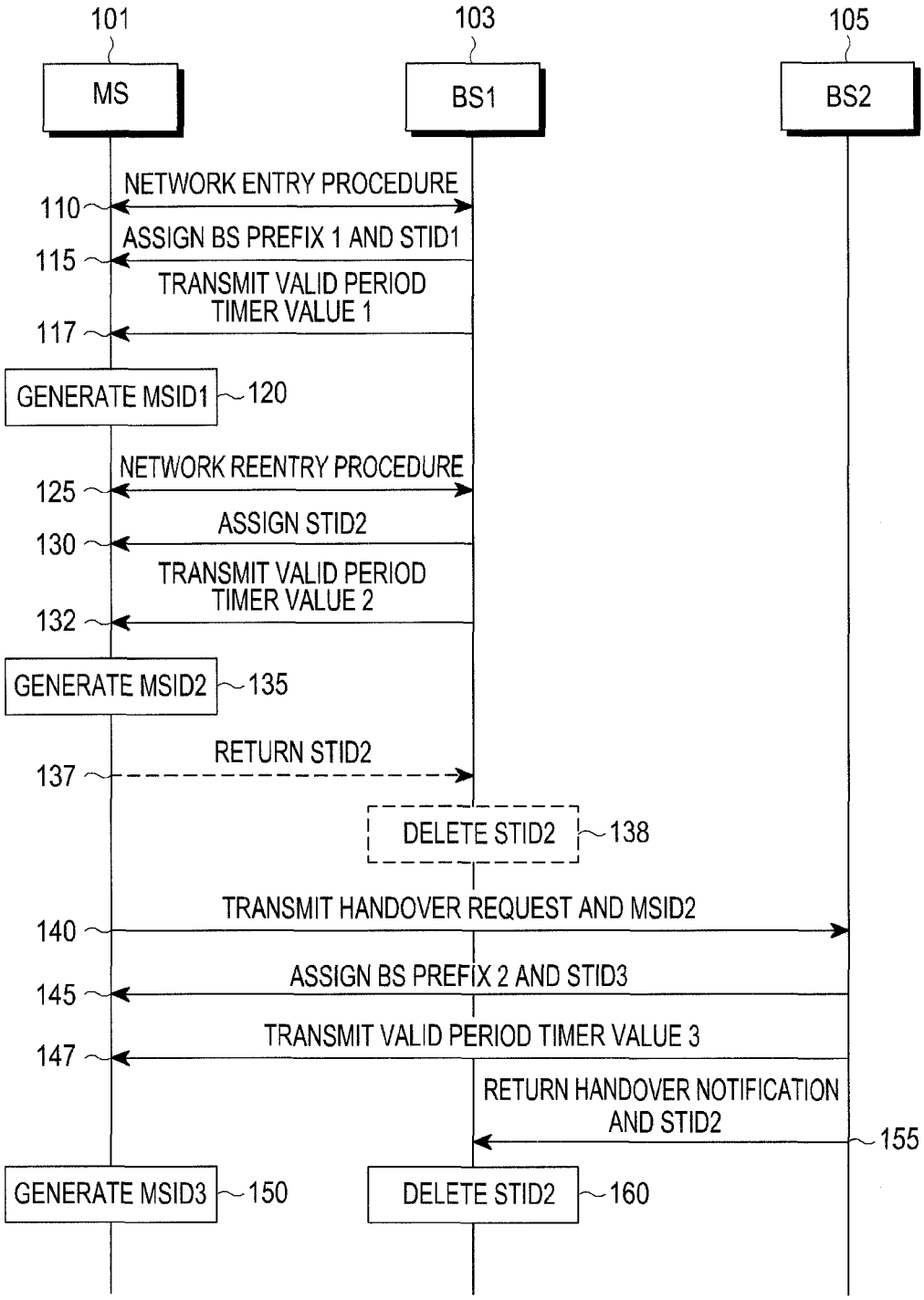
101
103
105
MS
BS1
BS2
NETWORK ENTRY PROCEDURE
110
ASSIGN BS PREFIX 1 AND STID1
115
TRANSMIT VALID PERIOD TIMER VALUE 1
117
GENERATE MSID1
120
NETWORK REENTRY PROCEDURE
125
ASSIGN STID2
130
TRANSMIT VALID PERIOD TIMER VALUE 2
132
GENERATE MSID2
135
RETURN STID2
137
DELETE STID2
138
TRANSMIT HANDOVER REQUEST AND MSID2
140
ASSIGN BS PREFIX 2 AND STID3
145
TRANSMIT VALID PERIOD TIMER VALUE 3
147
RETURN HANDOVER NOTIFICATION AND STID2
155
GENERATE MSID3
150
DELETE STID2
160

FIG.1

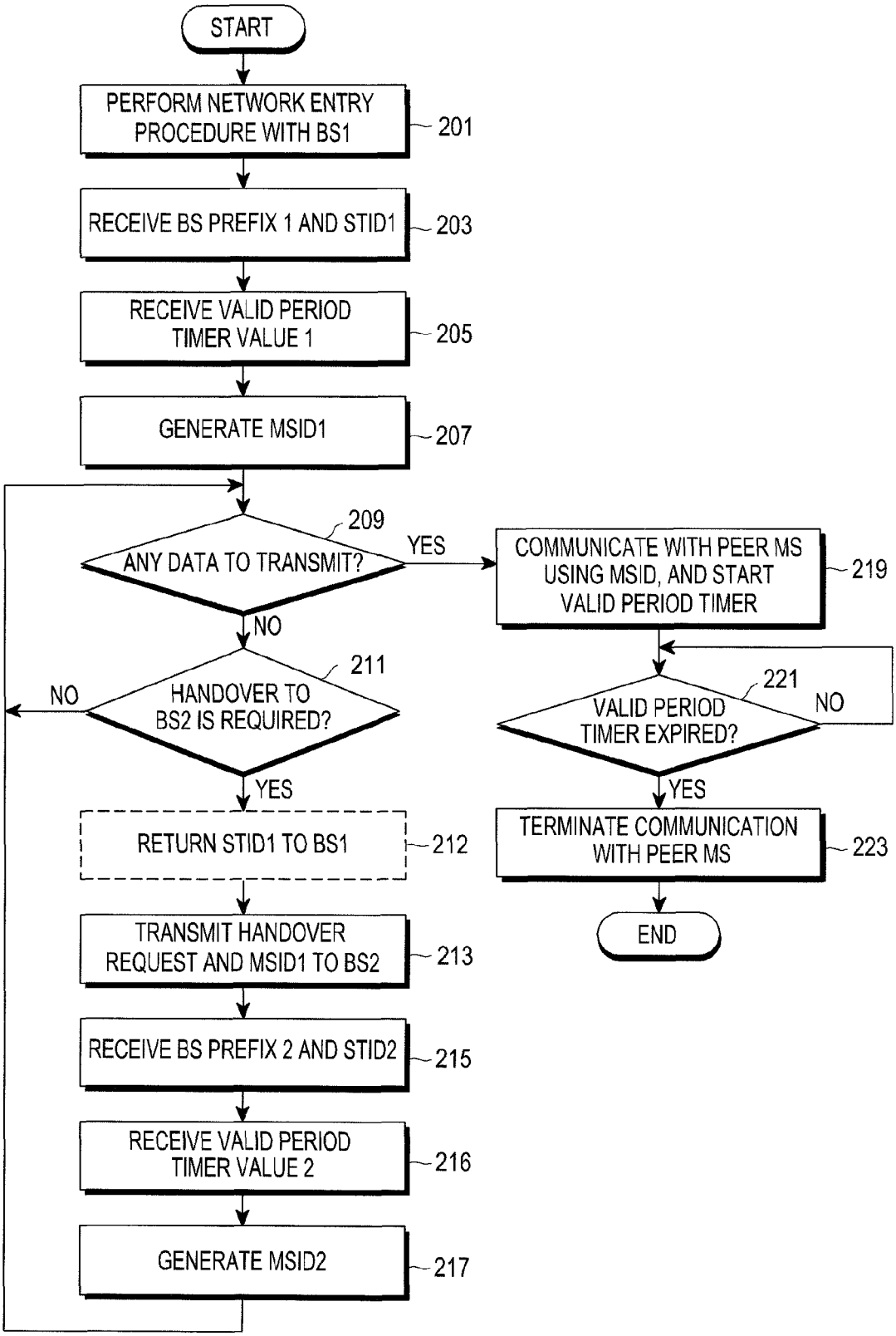
START
PERFORM NETWORK ENTRY PROCEDURE WITH BS1
201
RECEIVE BS PREFIX 1 AND STID1
203
RECEIVE VALID PERIOD TIMER VALUE 1
205
GENERATE MSID1
207
209
ANY DATA TO TRANSMIT?
YES
NO
COMMUNICATE WITH PEER MS USING MSID, AND START VALID PERIOD TIMER
219
211
HANDOVER TO BS2 IS REQUIRED?
NO
YES
221
VALID PERIOD TIMER EXPIRED?
NO
YES
RETURN STID1 TO BS1
212
TERMINATE COMMUNICATION WITH PEER MS
223
TRANSMIT HANDOVER REQUEST AND MSID1 TO BS2
213
END
RECEIVE BS PREFIX 2 AND STID2
215
RECEIVE VALID PERIOD TIMER VALUE 2
216
GENERATE MSID2
217

FIG.2

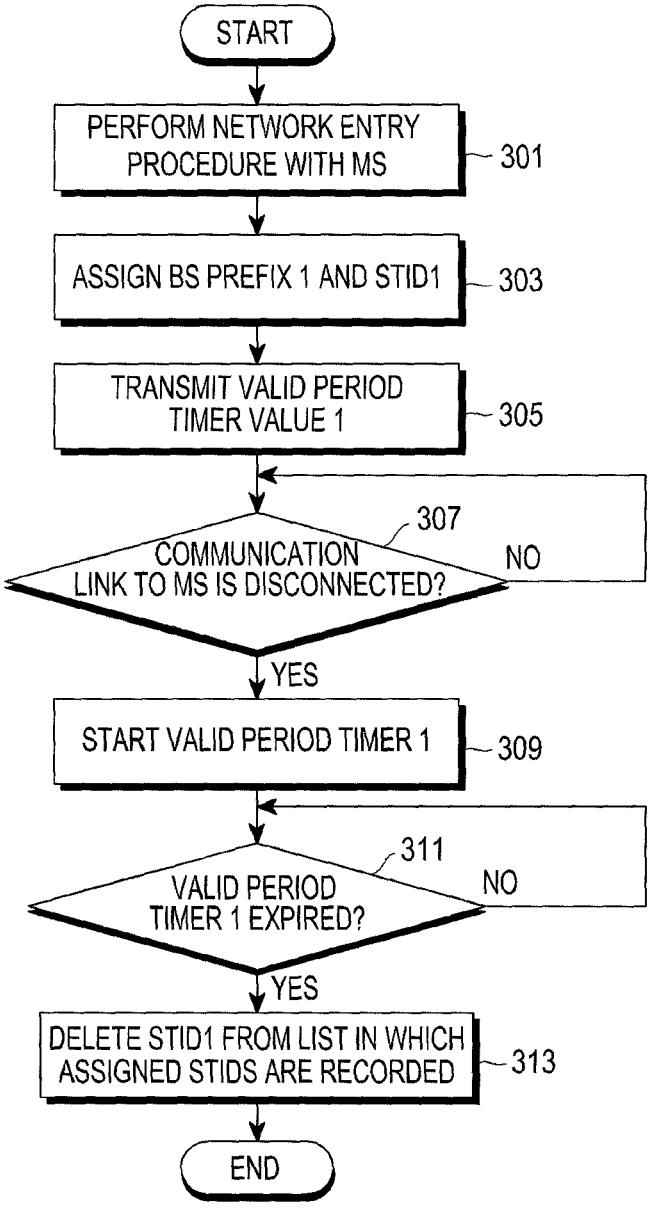
START
PERFORM NETWORK ENTRY PROCEDURE WITH MS
301
ASSIGN BS PREFIX 1 AND STID1
303
TRANSMIT VALID PERIOD TIMER VALUE 1
305
307
COMMUNICATION LINK TO MS IS DISCONNECTED?
NO
YES
START VALID PERIOD TIMER 1
309
311
VALID PERIOD TIMER 1 EXPIRED?
NO
YES
DELETE STID1 FROM LIST IN WHICH ASSIGNED STIDS ARE RECORDED
313
END

FIG.3

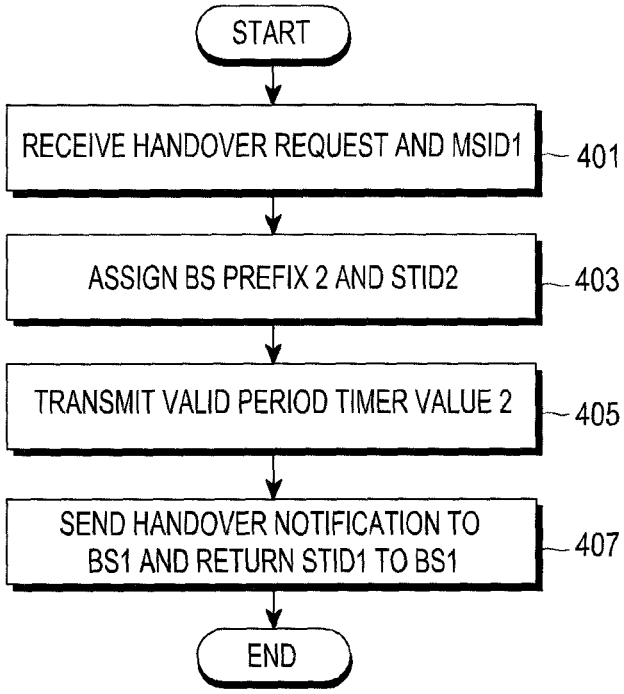
START
RECEIVE HANDOVER REQUEST AND MSID1
401
ASSIGN BS PREFIX 2 AND STID2
403
TRANSMIT VALID PERIOD TIMER VALUE 2
405
SEND HANDOVER NOTIFICATION TO BS1 AND RETURN STID1 TO BS1
407
END

FIG.4

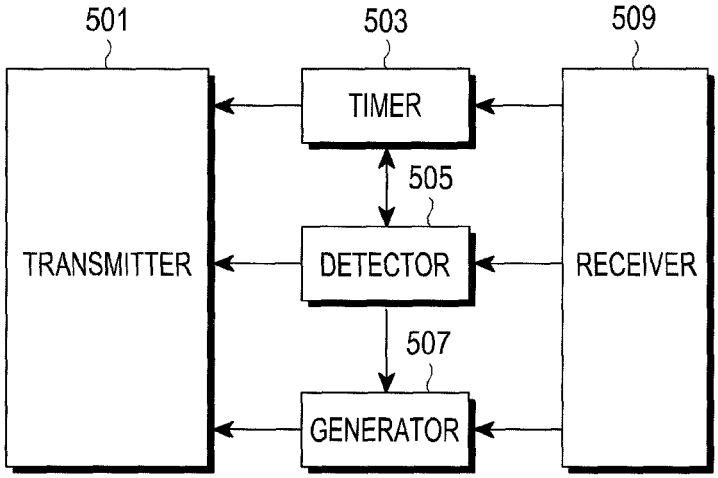
501
503
509
TIMER
505
TRANSMITTER
DETECTOR
RECEIVER
507
GENERATOR

FIG.5

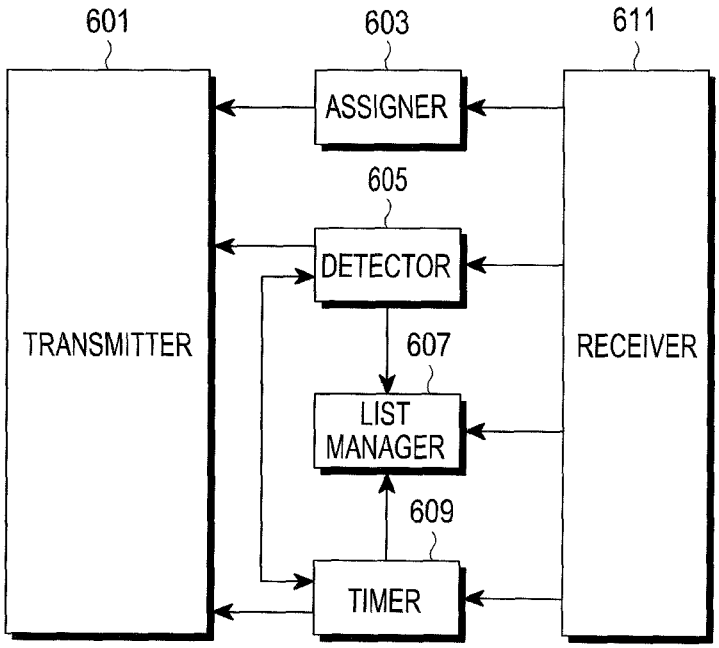
601
603
611
ASSIGNER
605
DETECTOR
TRANSMITTER
607
RECEIVER
LIST MANAGER
609
TIMER

FIG.6

METHOD AND APPARATUS FOR SUPPORTING DEVICE-TO-DEVICE COMMUNICATIONS

PRIORITY

This application claims the benefit under 35 U.S.C. §119(a) of a Korean patent application filed on Feb. 15, 2012 in the Korean Intellectual Property Office and assigned Serial No. 10-2012-0015221, the entire disclosure of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to Device-to-Device (D2D) communications. More particularly, the present invention relates to a method and an apparatus for supporting D2D communications that use device Identifiers (IDs).

2. Description of the Related Art

With advances in communication devices and communication systems, users of the communication devices require the services in which they can easily obtain their desired information at any time, or share the information with users of other devices or Mobile Stations (MSs). Recently, with the advent of smart devices, such as smart phones and tablet Personal Computers (PCs), an advanced environment has been established, in which users may obtain and share a wide variety of information through wireless communications.

However, in the case of wireless communication systems, users cannot obtain and share the desired information unless a communications infrastructure is built. In addition, it is not easy for the wireless communication systems to efficiently provide the real-time information which may be minor but useful in everyday life, due to the system complexity or time delay.

Accordingly, a D2D service has been emerged, which may take place through communication links between MSs without network entities, such as a Base Station (BS), in locations where no communications infrastructure is built.

In a cellular communication system, an MS performs communication using a temporary ID that is unique only in its BS and can be changed. For the temporary ID, its global uniqueness within the system is not guaranteed, but its security may be ensured. The term 'temporary ID' as used herein may refer to an ID that is assigned to an MS in order to access the BS.

On the other hand, an MS performing the D2D service performs communications using a Media Access Control (MAC) address. For the MAC address, its global uniqueness within the system may be guaranteed, but its security is vulnerable, so the location and other information of the MS may be exposed.

Therefore, there is a need for a way to perform communication using the IDs, whose global uniqueness within the system is guaranteed and whose security may be ensured like in the cellular communication system, in D2D communications.

The above information is presented as background information only to assist with an understanding of the present disclosure. No determination has been made, and no assertion is made, as to whether any of the above might be applicable as prior art with regard to the present invention.

SUMMARY OF THE INVENTION

Aspects of the present invention are to address the above-mentioned problems and/or disadvantages and to provide at least the advantages described below. Accordingly, an aspect of the present invention is to provide a method and an apparatus for supporting Device-to-Device (D2D) communications that use device Identifiers (IDs), in a communication system.

Another aspect of the present invention is to provide a method and an apparatus for supporting D2D communications that use device IDs, which can guarantee both their global uniqueness within the system and security.

In accordance with one aspect of the present invention, a method for supporting D2D communications by a Mobile Station (MS) in a communication system is provided. The method includes performing a network entry procedure with a Base Station (BS) and receiving, from the BS, a BS prefix, a temporary ID, and a valid period timer value for the temporary IDBS, generating a device ID using the BS prefix and the temporary ID, and performing, upon detecting data to be transmitted, communication with a peer MS using the device ID for a time indicated by the valid period timer value. The BS prefix may be information unique within the communication system, and the temporary ID may be information unique within a coverage area of the BS.

In accordance with another aspect of the present invention, a method for supporting D2D communications by a BS in a communication system is provided. The method includes performing a network entry procedure with an MS and transmitting, to the MS, a BS prefix, a temporary ID, and a valid period timer value for the temporary ID, upon detecting disconnection of a communication link to the MS, starting operation of a timer which is set depending on the valid period timer value, deleting, upon expiration of the timer, the temporary ID from a list in which the BS records temporary IDs assigned to the MS. The BS prefix may be information unique within the communication system, and the temporary ID may be information unique within a coverage area of the BS.

In accordance with another aspect of the present invention, a method for supporting D2D communications by a BS in a communication system is provided. The method includes receiving, from an MS, a device ID including a serving BS's prefix and a serving BS's temporary ID, transmitting, to the MS, a target BS's prefix, a target BS's temporary ID, and a valid period timer value for the target BS's temporary ID, and returning the serving BS's temporary ID to the serving BS which is detected from the serving BS's prefix. The serving BS's prefix and the target BS's prefix may be information unique within the communication system, the serving BS's temporary ID may be information unique within a coverage area of the serving BS, and the target BS's temporary ID may be information unique within a coverage area of the target BS.

In accordance with yet another aspect of the present invention, an MS apparatus for supporting D2D communications in a communication system is provided. The MS apparatus includes a receiver for performing a network entry procedure with a BS and for receiving, from the BS, a BS prefix, a temporary ID, and a valid period timer value for the temporary ID, a generator for generating a device ID using the BS prefix and the temporary ID, a detector for detecting data to be transmitted, and a transmitter for performing communication with a peer MS using the device ID for a time indicated by the valid period timer value, if the detector detects data to be transmitted. The BS prefix may be information unique within the communication system, and the temporary ID may be information unique within a coverage area of the BS.

In accordance with still another aspect of the present invention, a BS apparatus for supporting D2D communications in a communication system is provided. The BS apparatus includes a transmitter for performing a network entry proce-

dure with an MS and for transmitting, to the MS, a BS prefix, a temporary ID, and a valid period timer value for the temporary ID, a detector for detecting disconnection of a communication link to the MS, a timer for setting a timer value depending on the valid period timer value, and for starting operation thereof if the detector detects the disconnection of a communication link to the MS, and a list manager for deleting, upon expiration of the timer, the temporary ID from a list in which the BS records temporary IDs assigned to the MS. The BS prefix may be information unique within the communication system, and the temporary ID may be information unique within a coverage area of the BS.

In accordance with still another aspect of the present invention, a BS apparatus for supporting D2D communications in a communication system is provided. The BS apparatus includes a receiver for receiving, from an MS, a device ID including a serving BS's prefix and a serving BS's temporary ID, and a transmitter for transmitting, to the MS, a target BS's prefix, a target BS's temporary ID, and a valid period timer value for the target BS's temporary ID, and for returning the serving BS's temporary ID to the serving BS which is detected from the serving BS's prefix. The serving BS's prefix and the target BS's prefix may be information unique within the communication system, the serving BS's temporary ID may be information unique within a coverage area of the serving BS, and the target BS's temporary ID may be information unique within a coverage area of the target BS.

Other aspects, advantages, and salient features of the invention will become apparent to those skilled in the art from the following detailed description, which, taken in conjunction with the annexed drawings, discloses exemplary embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects, features, and advantages of certain exemplary embodiments of the present invention will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:

FIG. **1** illustrates a Device-to-Device (D2D) communication procedure that uses device Identifiers (IDs), according to an exemplary embodiment of the present invention;

FIG. **2** is a flowchart illustrating a Mobile Station's (MS's) operation of performing D2D communications that use device IDs, according to an exemplary embodiment of the present invention;

FIG. **3** is a flowchart illustrating a Base Station **1**'s (BS**1**'s) operation of supporting D2D communications that use device IDs, according to an exemplary embodiment of the present invention;

FIG. **4** is a flowchart illustrating a BS**2**'s operation of supporting D2D communications that use device IDs, according to an exemplary embodiment of the present invention;

FIG. **5** illustrates a block diagram of an MS performing D2D communications that use device IDs, according to an exemplary embodiment of the present invention; and

FIG. **6** illustrates a block diagram of a BS supporting D2D communications that use device IDs, according to an exemplary embodiment of the present invention.

Throughout the drawings, the same drawing reference numerals will be understood to refer to the same elements, features and structures.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

The following description with reference to the accompanying drawings is provided to assist in a comprehensive understanding of exemplary embodiments of the invention as defined by the claims and their equivalents. It includes various specific details to assist in that understanding but these are to be regarded as merely exemplary. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the invention. In addition, descriptions of well-known functions and constructions may be omitted for clarity and conciseness.

The terms and words used in the following description and claims are not limited to the bibliographical meanings, but, are merely used by the inventor to enable a clear and consistent understanding of the invention. Accordingly, it should be apparent to those skilled in the art that the following description of exemplary embodiments of the present invention is provided for illustration purpose only and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.

It is to be understood that the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to "a component surface" includes reference to one or more of such surfaces.

By the term "substantially" it is meant that the recited characteristic, parameter, or value need not be achieved exactly, but that deviations or variations, including for example, tolerances, measurement error, measurement accuracy limitations and other factors known to those of skill in the art, may occur in amounts that do not preclude the effect the characteristic was intended to provide.

Exemplary embodiments of the present invention relate to a method and an apparatus for supporting Device-to-Device (D2D) communications that use device Identifiers (IDs).

FIG. **1** illustrates a D2D communication procedure that uses device IDs, according to an exemplary embodiment of the present invention.

Referring to FIG. **1**, a Mobile Station (MS) **101** accesses its neighbor Base Station (BS), for example, a first BS (BS**1**) **103**, and performs a network entry procedure with the BS**1** **103** in step **110**. Thereafter, the BS**1** **103** assigns a first BS prefix and a first temporary ID to the MS **101** in step **115**. The temporary ID, which is assigned to ensure its security, may refer to an ID which is unique only within the coverage area of the BS, with which the MS has completed the network entry procedure, and which can be changed at any time. The temporary ID will be referred to herein as a Station ID (STID), and the first STID that the MS **101** is assigned from the BS**1** **103**, is valid only in the coverage area of the BS**1** **103**.

A BS prefix is assigned to ensure the global uniqueness within the system, and may be comprised of the following values.

BS Prefix=(Operator ID+BS ID), or (Nation ID+Operator ID+BS ID), or (Type+Operator ID+BS ID), or (Type+Nation ID+Operator ID+BS ID).

The operator ID is unique information of each operator, and this information is distinguishable for each system. The BS ID is for identifying a BS within the system indicated by the operator ID, and that is the information which is unique only within the system. The nation ID is information that is unique only in the nation or state, and the type is information indicating the system type.

As such, the BS prefix may be configured in a variety of ways by a combination of the above-described IDs, and the BS prefix is configured to include the operator ID to ensure the global uniqueness within the system. The above information constituting the BS prefix may be included in cell infor-

mation, or may be transmitted from a BS to an MS by being comprised of separate information.

In addition to assigning the first BS prefix and the first STID to the MS **101** in step **115**, the BS**1** **103** transmits a first valid period timer value of the first STID to the MS **101** in step **117**. The MS **101** generates a first device ID using the first BS prefix and the first STID that it has been assigned from the BS**1** **103**, in step **120**. Although not illustrated, the MS **101** may perform communication, for a time indicated by the first valid period timer value using the generated first device ID during its further communication, with the peer MS (not shown) it wants to communicate with. For example, if it is assumed that the first BS prefix is comprised of N bits and the first STID is comprised of M bits, the first device ID is comprised of M+N bits.

The time indicated by the valid period timer refers to the time for which the MS **101** can communicate with the peer MS using the first device ID. The device ID will be referred to herein as an MSID. The MSID is generated by a sum of a BS prefix assigned to ensure the global uniqueness within the system and an STID assigned to ensure the security. Therefore, the MSID may guarantee both of the global uniqueness within the system and the security.

The first valid period timer does not operate while the MS **101** is connected to the BS**1** **103**, and operation of the first valid period timer is started beginning at the time the MS **101** starts its communication with the peer MS after disconnecting the communication link to the BS**1** **103**. The first valid period timer value is a value that each of the MS **101** and the BS**1** **103** needs to maintain. The MS **101** starts operation of the first valid period timer at the time its communication with the peer MS starts, and the BS**1** **103** starts operation of the first valid period timer at the time its communication link to the MS **101** is disconnected. If the first valid period timer has expired, the MS **101** terminates its communication with the peer MS and the BS**1** **103** deletes the first STID from a list in which it records assigned STIDs. If the MS **101** re-accesses the BS**1** **103** through the network reentry procedure before the first valid period timer expires, the first valid period timer's value is initialized.

It will be assumed herein that the MS **101** re-accesses the BS**1** **103** before the first valid period timer expires.

In step **125**, the MS **101** performs the network reentry procedure with the BS**1** **103** and the first valid period timer value is initialized. The BS**1** **103** assigns a second STID generated by the network reentry to the MS **101** in step **130**, and transmits a second valid period timer value of the second STID to the MS **101** in step **132**. The BS prefix information is not newly assigned, since it is the same as the information assigned in step **115**.

In step **135**, the MS **101** generates a second MSID using the first BS prefix and the second STID. Although not illustrated, the MS **101** may perform communication for a time indicated by the second valid period timer value using the generated second MSID during its further communication with the peer MS.

In step **140**, upon request for handover from the BS**1** **103** to another neighbor BS, for example, a second BS (BS**2**) **105**, the MS **101** sends a handover request message to the BS**2** **105**. The MS **101** transmits the second MSID information along with the handover request message.

The BS**2** **105** assigns a second BS prefix and a third STID to the MS **101** in step **145**, and transmits a third valid period timer value of the third STID in step **147**. In step **150**, the MS **101** generates a third MSID using the second BS prefix and the third STID it has been assigned from the BS**2** **105**. Although not illustrated, the MS **101** may perform communication for a time indicated by the third valid period timer value using the generated third MSID during its further communication with the peer MS.

In step **155**, the BS**2** **105** obtains the first BS prefix and the second STID information from the second MSID received in step **140**, and sends a handover notification message to the BS**1** **103**, which is detected based on the first BS prefix information. The BS**2** **105** returns the second STID to the BS**1** **103**. In step **160**, the BS**1** **103** deletes the returned second STID from the list in which it records assigned STIDs.

Although it is assumed in FIG. **1** that the BS**2** **105** returns the second STID to the BS**1** **103** after the MS **101** performs handover to the BS**2** **105**, the second STID may be returned before the MS **101** performs handover to the BS**2** **105**. More specifically, upon request for handover to the BS**2** **105**, the MS **101** may return the second STID to the BS**1** **103** in step **137** before handling handover request to the BS**2** **105** in step **140**, and the BS**1** **103** may delete the returned second STID from the list in which it records assigned STIDs, in step **138**. In this case, the MS **101** does not need to transmit the second MSID information upon request for handover.

FIG. **2** is a flowchart illustrating an MS's operation of performing D2D communications that use device IDs, according to an exemplary embodiment of the present invention.

Referring to FIG. **2**, in step **201**, the MS accesses its neighbor BS, for example, a BS**1**, and performs the network entry procedure with the BS**1**.

The MS is assigned a first BS prefix and a first STID from the BS**1**, in step **203**, and receives a first valid period timer value transmitted from the BS**1**, in step **205**.

Thereafter, in step **207**, the MS generates a first MSID using the first BS prefix and the first STID that it has been assigned in step **203**. The first BS prefix is information assigned to ensure the global uniqueness within the system, and the first STID is information assigned to ensure the security. The first valid period timer value refers to the time for which the MS can communicate with the peer MS using the first MSID it has generated in step **207**. The first MSID, which is generated using the first BS prefix and the first STID, may guarantee both the global uniqueness within the system and the security.

In step **209**, the MS determines whether there is any data to be transmitted. If there is data to be transmitted, the MS starts, in step **219**, its communication with the peer MS using the first MSID it has generated in step **207**. When starting its communication with the peer MS, the MS starts operation of the first valid period timer that operates depending on the first valid period timer value it has received in step **205**.

Thereafter, in step **221**, the MS determines whether the first valid period timer has expired, the operation of which was started in step **219**. Step **221** is repeatedly performed until the first valid period timer expires, and upon expiration of the first valid period timer, the MS terminates its communication with the peer MS in step **223**.

On the other hand, if it is determined in step **209** that there is no data to be transmitted, the MS determines in step **211** whether handover to another neighbor BS, for example, a BS**2**, is required. If the handover to the BS**2** is not required, the MS returns to step **209** to determine again whether there is any data to be transmitted. However, if the handover to the BS**2** is required, the MS requests handover by sending a handover request message to the BS**2** and at the same time, transmits the first MSID information it generated in step **207**, in step **213**.

Thereafter, the MS is assigned a second BS prefix and a second STID from the BS**2**, in step **215**, and receives a second

valid period timer value transmitted from the BS2 in step **216**. Thereafter, in step **217**, the MS generates a second MSID using the second BS prefix and the second STID it has been assigned in step **215**, and returns to step **209**.

In step **209**, the MS determines whether there is any data to be transmitted. If there is data to be transmitted, the MS starts, in step **219**, its communication with the peer MS using the second MSID it has generated in step **217**. When starting the communication with the peer MS, the MS starts operation of the second valid period timer that operates depending on the second valid period timer value it received in step **216**.

Thereafter, in step **221**, the MS determines whether the second valid period timer has expired, the operation of which was started in step **219**. If the second valid period timer has expired, the MS terminates its communication with the peer MS in step **223**.

It will be assumed in FIG. **2** that the BS2 returns the assigned first STID to the BS1 after the MS performs handover. However, in some cases, the assigned first STID may be returned before the MS performs handover. In this case, the assigned first STID is returned to the BS1 from the MS.

Therefore, if the assigned first STID is returned from the MS to the BS1 in this way, step **212** may be performed between steps **211** and **213**. More specifically, if the handover to the BS2 is required in step **211**, the MS returns the assigned first STID to the BS1 in step **212**. In step **213**, the MS requests handover by sending a handover request message to the BS2. In this case, the MS does not need to transmit the first MSID information, upon request for handover.

Although not illustrated, the MS may perform the network reentry procedure with the BS1 before performing handover. More specifically, the MS may access the BS1 while performing the communication with the peer MS. In this case, a value of the first valid period timer is initialized, that counts the MS's communication time with the peer MS. In addition, the MS is assigned a new STID from the BS1, and receives a valid period timer value for the new STID together with the new STID.

If there is any data to be transmitted, the MS performs communication with the peer MS with a new MSID that is generated using the assigned first BS prefix and the new STID. The time for which the MS performs the communication may be determined depending on the time indicated by the valid period timer value for the new STID.

FIG. **3** is a flowchart illustrating a BS1's operation of supporting D2D communications that use device IDs, according to an exemplary embodiment of the present invention.

Referring to FIG. **3**, the BS1 performs the network entry procedure with the MS that has accessed to the BS1 itself, in step **301**.

The BS1 assigns its BS prefix and STID, i.e., a first BS prefix and a first STID, to the MS, in step **303**, and transmits a first valid period timer value for the first STID to the MS in step **305**.

Thereafter, in step **307**, the BS1 determines whether its communication link to the MS is disconnected. The expression 'the communication link between the BS1 and the MS is disconnected' means that the MS begins its communication with the peer MS. Step **307** is repeatedly performed until the BS1's communication link to the MS is disconnected. Upon detecting the disconnection of its communication link to the MS, the BS1 starts operation of the first valid period timer that operates depending on the first valid period timer value, in step **309**.

Thereafter, in step **311**, the BS1 determines whether the first valid period timer has expired, operation of which was started in step **309**. Step **311** is repeatedly performed until the first valid period timer expires, and upon expiration of the first valid period timer, the BS1 deletes, in step **313**, the first STID which was assigned in step **303**, from the list in which it records assigned STIDs.

It is assumed in FIG. **3** that upon the expiration of the valid period timer, the STID is deleted. However, the operation of deleting a specific STID from the list, in which assigned STIDs are recorded, may be performed even when the STID is returned from the MS or other BSs except for the BS1.

FIG. **4** is a flowchart illustrating a BS2's operation of supporting D2D communications that use device IDs, according to an exemplary embodiment of the present invention.

Referring to FIG. **4**, in step **401**, the target BS, for example, the BS2, to which the MS will perform handover, receives a handover request and first MSID information from the MS. The first MSID refers to an MSID of the current serving BS, for example, the BS1 of the MS.

The BS2 assigns its BS prefix and STID, i.e., a second BS prefix and a second STID, to the MS in step **403**, and transmits a second valid period timer value for the second STID in step **405**. The second valid period timer value refers to the time for which the MS can communicate with the peer MS with the second MSID that is generated using the second BS prefix and the second STID.

Thereafter, in step **407**, the BS2 returns the first STID to the BS, for example, the BS1, which is detected based on the first BS prefix information which is acquired from the first MSID that the BS2 received in step **401**.

It is assumed in FIG. **4** that the BS2 returns the assigned first STID to the BS1 after the MS performs handover to the BS2. However, in some cases, the assigned first STID may be returned before the MS performs handover. In this case, the assigned first STID is returned to the BS1 from the MS. Therefore, if the assigned first STID is returned from the MS to the BS1 in this way, the operation of receiving the first MSID information by the BS2 in step **401**, and the operation of returning the first STID by the BS2 in step **407** may be omitted.

FIG. **5** illustrates a block diagram of an MS performing D2D communications that use device IDs, according to an exemplary embodiment of the present invention.

Referring to FIG. **5**, a transmitter **501** and a receiver **509** of the MS perform the network entry procedure with a neighbor BS, and the receiver **509** receives a BS prefix, an STID and a valid period timer value for the STID from the neighbor BS (or a serving BS).

A generator **507** generates an MSID using the BS prefix and STID received from the receiver **509**. The BS prefix is information assigned to ensure the global uniqueness within the system, and the STID is information assigned to secure the security. The valid period timer value refers to the time for which the MS can communicate with the peer MS using the generated MSID. The MSID, which is generated using the BS prefix and the STID, may guarantee both the global uniqueness within the system and the security.

A detector **505** determines whether there is any data to be transmitted. If the detector **505** detects data to be transmitted, the transmitter **501** transmits the detected data using the MSID generated by the generator **507**. As the same time, a timer **503** starts its operation. The timer **503** is set depending on the valid period timer value for the STID. If the timer **503** expires, the transmitter **501** terminates its data transmission.

If the detector **505** detects a handover from the current serving BS to another neighbor BS (or a target BS), the transmitter **501** returns the STID of the serving BS to the serving BS, and sends a handover request to the target BS.

The receiver **509** receives a new BS prefix, a new STID and a valid period timer value for the new STID from the target BS.

When not returning the STID of the serving BS to the serving BS, the transmitter **501** transmits the MSID of the serving BS to the target BS along with the handover request.

FIG. **6** illustrates a block diagram of a BS supporting D2D communications that use device IDs, according to an exemplary embodiment of the present invention.

Referring to FIG. **6**, a transmitter **601** and a receiver **611** of the BS perform the network entry procedure with an MS. An assigner **603** assigns a BS prefix and an STID to the MS, and the transmitter **601** transmits a valid period timer value for the STID.

A detector **605** determines whether the BS's communication link to the MS is disconnected. If the detector **605** detects the disconnection of the communication link, a timer **609** starts its operation. The timer **609** is set depending on the valid period timer value for the STID. If the timer **609** expires, a list manager **607** deletes the STID from its own list in which it records assigned STIDs.

Even if the detector **605** detects an STID which is returned from the MS or other BSs, the list manager **607** deletes the returned STID from its own list.

The receiver **611** receives a handover request and MSID information for another BS from the MS. The assigner **603** assigns its BS prefix and STID, and the transmitter **601** transmits the BS prefix and STID assigned by the assigner **603**, and a valid period timer value for the STID.

The detector **605** acquires BS prefix and STID information of another BS by receiving MSID information of another BS from the receiver **611**, and detects the BS based on the BS prefix information of another BS. The transmitter **601** returns the STID to the detected BS.

As is apparent from the foregoing description, the disclosed exemplary embodiments of the present invention may perform D2D communications using device IDs which can guarantee both of the global uniqueness within the system and the security, enabling more effective communications.

While the invention has been shown and described with reference to certain exemplary embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims and their equivalents.

What is claimed is:

1. A method for supporting device-to-device (D2D) communications by a mobile station (MS) in a communication system, the method comprising:

performing a network entry procedure with a base station (BS) and receiving, from the BS, a BS prefix, a temporary identifier (ID), and a valid period timer value for the temporary ID;

generating a device ID based on the BS prefix and the temporary ID; and

performing, upon detecting data to be transmitted, communication with a peer MS based on the device ID for a time indicated by the valid period timer value,

wherein the BS prefix is information unique within the communication system, and the temporary ID is information unique within a coverage area of the BS.

2. The method of claim **1**, further comprising:

upon request for handover from the BS to a neighbor BS, transmitting the device ID to the neighbor BS;

receiving, from the neighbor BS, a neighbor BS's prefix, a neighbor BS's temporary ID, and a valid period timer value for the neighbor BS's temporary ID;

generating a new device ID based on the neighbor BS's prefix and the neighbor BS's temporary ID; and

performing, upon detecting data to be transmitted, communication with a peer MS based on the new device ID for a time indicated by the valid period timer value for the neighbor BS's temporary ID.

3. The method of claim **1**, further comprising:

returning the temporary ID to the BS, upon request for handover from the BS to a neighbor BS;

receiving, from the neighbor BS, a neighbor BS's prefix, a neighbor BS's temporary ID, and a valid period timer value for the neighbor BS's temporary ID;

generating a new device ID based on the neighbor BS's prefix and the neighbor BS's temporary ID; and

performing, upon detecting data to be transmitted, communication with a peer MS based on the new device ID for a time indicated by the valid period timer value for the neighbor BS's temporary ID.

4. The method of claim **1**, further comprising:

performing a network reentry procedure with the BS, and receiving, from the BS, a new temporary ID generated by the network reentry and a valid period timer value for the new temporary ID;

generating a new device ID based on the BS prefix and the new temporary ID; and

performing, upon detecting data to be transmitted, communication with a peer MS based on the new device ID for a time indicated by the valid period timer value for the new temporary ID.

5. A method for supporting device-to-device (D2D) communications by a base station (BS) in a communication system, the method comprising:

performing a network entry procedure with a mobile station (MS) and transmitting, to the MS, a BS prefix, a temporary identifier (ID), and a valid period timer value for the temporary ID;

upon detecting disconnection of a communication link to the MS, starting operation of a timer which is set based on the valid period timer value; and

deleting, upon expiration of the timer, the temporary ID from a list in which the BS records temporary IDs assigned to the MS,

wherein the BS prefix is information unique within the communication system, and the temporary ID is information unique within a coverage area of the BS.

6. The method of claim **5**, further comprising:

receiving the temporary ID which is returned from the MS or a neighbor BS; and

deleting the returned temporary ID from a list in which the BS records temporary IDs assigned to the MS.

7. The method of claim **5**, further comprising:

performing a network reentry procedure with the MS, and transmitting, to the MS, a new temporary ID and a valid period timer value for the new temporary ID;

upon detecting disconnection of a communication link to the MS, starting operation of a timer which is set depending on the valid period timer value for the new temporary ID; and

deleting, upon expiration of the timer, the new temporary ID from the list in which the BS records temporary IDs assigned to the MS.

8. A method for supporting device-to-device (D2D) communications by a base station (BS) in a communication system, the method comprising:

receiving, from a mobile station (MS), a device identifier (ID) including a serving BS's prefix and a serving BS's temporary ID;

transmitting, to the MS, a target BS's prefix, a target BS's temporary ID, and a valid period timer value for the target BS's temporary ID; and

returning the serving BS's temporary ID to the serving BS which is detected from the serving BS's prefix,

wherein the serving BS's prefix and the target BS's prefix are information unique within the communication system, the serving BS's temporary ID is information unique within a coverage area of the serving BS, and the target BS's temporary ID is information unique within a coverage area of the target BS.

9. A mobile station (MS) apparatus for supporting device-to-device (D2D) communications in a communication system, the method comprising:

a receiver configured to:

perform a network entry procedure with a base station (BS), and

receive, from the BS, a BS prefix, a temporary identifier (ID), and a valid period timer value for the temporary ID;

a generator configured to generate a device ID based on the BS prefix and the temporary ID;

a detector configured to detect data to be transmitted; and

a transmitter configured to perform communication with a peer MS based on the device ID for a time indicated by the valid period timer value, if the detector detects data to be transmitted,

wherein the BS prefix is information unique within the communication system, and the temporary ID is information unique within a coverage area of the BS.

10. The MS apparatus of claim **9**,

wherein, if the detector detects a request for handover from the BS to a neighbor BS, the transmitter is further configured to transmit the device ID to the neighbor BS,

wherein the receiver is further configured to receive, from the neighbor BS, a neighbor BS's prefix, a neighbor BS's temporary ID, and a valid period timer value for the neighbor BS's temporary ID,

wherein the generator is further configured to generate a new device ID based on the neighbor BS's prefix and the neighbor BS's temporary ID, and

wherein, if the detector detects data to be transmitted, the transmitter and the receiver are further configured to perform communication with a peer MS based on the new device ID for a time indicated by the valid period timer value for the neighbor BS's temporary ID.

11. The MS apparatus of claim **9**,

wherein, if the detector detects a request for handover from the BS to a neighbor BS, the receiver is further configured to receive, from the neighbor BS, a neighbor BS's prefix, a neighbor BS's temporary ID, and a valid period timer value for the neighbor BS's temporary ID,

wherein the generator is further configured to generate a new device ID based on the neighbor BS's prefix and the neighbor BS's temporary ID, and

wherein, if the detector detects data to be transmitted, the transmitter and the receiver are further configured to perform communication with a peer MS based on the new device ID for a time indicated by the valid period timer value for the neighbor BS's temporary ID.

12. The MS apparatus of claim **9**,

wherein the receiver is further configured to:

perform a network reentry procedure with the BS, and

receive, from the BS, a new temporary ID generated by the network reentry and a valid period timer value for the new temporary ID,

wherein the generator is further configured to generate a new device ID based on the BS prefix and the new temporary ID, and

wherein, if the detector detects data to be transmitted, the transmitter and the receiver are further configured to perform communication with a peer MS based on the new device ID for a time indicated by the valid period timer value for the new temporary ID.

13. A base station (BS) apparatus for supporting device-to-device (D2D) communications in a communication system, the apparatus comprising:

a transmitter configured to:

perform a network entry procedure with a mobile station (MS), and

transmit, to the MS, a BS prefix, a temporary identifier (ID), and a valid period timer value for the temporary ID;

a detector configured to detect disconnection of a communication link to the MS;

a timer configured to:

set a timer value based on the valid period timer value, and

start operation thereof, if the detector detects the disconnection of a communication link to the MS; and

a list manager configured to delete, upon expiration of the timer, the temporary ID from a list in which the BS records temporary IDs assigned to the MS,

wherein the BS prefix is information unique within the communication system, and the temporary ID is information unique within a coverage area of the BS.

14. The BS apparatus of claim **13**,

wherein the receiver is further configured to receive the temporary ID which is returned from the MS or a neighbor BS, and

wherein the list manager is further configured to delete the returned temporary ID from the list in which the BS records temporary IDs assigned to the MS.

15. The BS apparatus of claim **13**,

wherein the transmitter is further configured to:

perform a network reentry procedure with the MS, and

transmit a new temporary ID and a valid period timer value for the new temporary ID, to the MS,

wherein the timer is further configured to:

set a timer value depending on the valid period timer value for the new temporary ID, and

start operation thereof, if the detector detects the disconnection of a communication link to the MS, and

wherein, if the timer expires, the list manager is further configured to delete the new temporary ID from the list in which the BS records temporary IDs assigned to the MS.

16. A base station (BS) apparatus for supporting device-to-device (D2D) communications in a communication system, the apparatus comprising:

a receiver configured to receive, from a mobile station (MS), a device identifier (ID) including a serving BS's prefix and a serving BS's temporary ID; and

a transmitter configured to:

transmit, to the MS, a target BS's prefix, a target BS's temporary ID, and a valid period timer value for the target BS's temporary ID, and

return the serving BS's temporary ID to the serving BS which is detected from the serving BS's prefix,

wherein the serving BS's prefix and the target BS's prefix are information unique within the communication system, the serving BS's temporary ID is information unique within a coverage area of the serving BS, and the target BS's temporary ID is information unique within a coverage area of the target BS.

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